Model: CAT1

Microprocessor Controlled Two-Wire 4-20mA Loop Powered Transmitter

USER'S MANUAL

HP-310
October 2015

HOFFER FLOW CONTROLS, INC.
PERFECTING MEASUREMENT ™

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NOTICE

HOFFER FLOW CONTROLS, INC. makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

This manual has been provided as an aid in installing, connecting, calibrating, operating, and servicing this unit. Every precaution for accuracy has been taken in the preparation of this manual; however, HOFFER FLOW CONTROLS, INC. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that may result from the use of the products in accordance with information contained in the manual.
HOFFER FLOW CONTROLS' policy is to provide a user manual for each item supplied. Therefore, all applicable user manuals should be examined before attempting to install or otherwise connect a number of related subsystems.

During installation, care must be taken to select the correct interconnecting wiring drawing. The choice of an incorrect connection drawing may result in damage to the system and/or one of the components.

Please review the complete model number of each item to be connected and locate the appropriate manual(s) and/or drawing(s). Identify all model numbers exactly before making any connections. A number of options and accessories may be added to the main instrument, which are not shown on the basic user wiring. Consult the appropriate option or accessory user manual before connecting it to the system. In many cases, a system wiring drawing is available and may be requested from HOFFER FLOW CONTROLS.

HOFFER FLOW CONTROLS' policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering. The information contained in this document is subject to change without notice.

Return Requests / Inquiries

Direct all warranty and repair requests/inquiries to the Hoffer Flow Controls Customer Service Department, telephone number (252) 331-1997 or 1-800-628-4584. BEFORE RETURNING ANY PRODUCT(S) TO HOFFER FLOW CONTROLS, PURCHASER MUST OBTAIN A RETURNED MATERIAL AUTHORIZATION (RMA) NUMBER FROM HOFFER FLOW CONTROLS' CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned RMA number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting HOFFER FLOW CONTROLS:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS OR CALIBRATIONS, consult HOFFER FLOW CONTROLS for current repair/ calibration charges. Have the following information available BEFORE contacting HOFFER FLOW CONTROLS:

1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of the product and
3. Repair instructions and/or specific problems relative to the product.

Limited Warranty

HOFFER FLOW CONTROLS, INC. ("HFC") warrants HFC's products ("goods") described in the specifications incorporated in this manual to be free from defects in material and workmanship under normal use and service, but only if such goods have been properly selected for the service intended, properly installed and properly operated and maintained. This warranty shall extend for a period of one (1) year from the date of delivery to the original purchaser (or eighteen (18) months if the delivery to the original purchaser occurred outside the continental United States). This warranty is extended only to the original purchaser ("Purchaser"). *Purchaser's sole and exclusive remedy is the repair and/or replacement of nonconforming goods as provided in the following paragraphs.*

In the event Purchaser believes the goods are defective, the goods must be returned to HFC, transportation prepaid by Purchaser, within twelve (12) months after delivery of goods (or eighteen (18) months for goods delivered outside he continental United States) for inspection by HFC. If HFC's inspection determines that the workmanship or materials are defective, the goods will be either repaired or replaced, at HFC's sole determination, free of additional charge, and the goods will be returned, transportation paid by HFC, using he lowest cost transportation available.

Prior to returning the goods to HFC, Purchaser must obtain a Returned Material Authorization (RMA) Number from HFC's Customer Service Department within 30 days after discovery of a purported breach of warranty, but no later than the warranty period; otherwise, such claims shall be deemed waived. See the Return Requests/Inquiries Section of this manual.

If HFC's inspection reveals the goods are free of defects in material and workmanship or such inspection reveals the goods were improperly used, improperly installed, and/or improperly selected for service intended, HFC will notify the purchaser in writing and will deliver the goods back to Purchaser upon (i) receipt of Purchaser's written instructions and (ii) the cost of transportation. If Purchaser does not respond within thirty (30) days after notice from HFC, the goods will be disposed of in HFC's discretion.

HFC does not warrant these goods to meet the requirements of any safety code of any state, municipality, or other jurisdiction, and Purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other machines or apparatus.

This warranty shall not apply to any HFC goods or parts thereof, which have been repaired outside HFC's factory or altered in any way, or have been subject to misuse, negligence, or accident, or have not been operated in accordance with HFC's printed instructions or have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications for such goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. HFC SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE RESULTING, DIRECTLY OR INDIRECTLY, FROM THE USE OR LOSS OF USE OF THE GOODS. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, THIS EXCLUSION FROM LIABILITY EMBRACES THE PURCHASER'S EXPENSES FOR DOWNTIME OR FOR MAKING UP DOWNTIME, DAMAGES FOR WHICH THE PURCHASER MAY BE LIABLE TO OTHER PERSONS, DAMAGES TO PROPERTY, AND INJURY TO OR DEATH OF ANY PERSONS. HFC NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OR USE OF HFC'S GOODS, AND THERE ARE NO ORAL AGREEMENTS OR WARRANTIES COLLATERAL TO OR AFFECTING THE AGREEMENT. *PURCHASER'S SOLE AND EXCLUSIVE REMEDY IS THE REPAIR AND/OR REPLACEMENT OF NONCONFORMING GOODS AS PROVIDED IN THE PRECEDING PARAGRAPHS. HFC SHALL NOT BE LIABLE FOR ANY OTHER DAMAGES WHATSOEVER INCLUDING INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.*

CONTENTS

1. Introduction

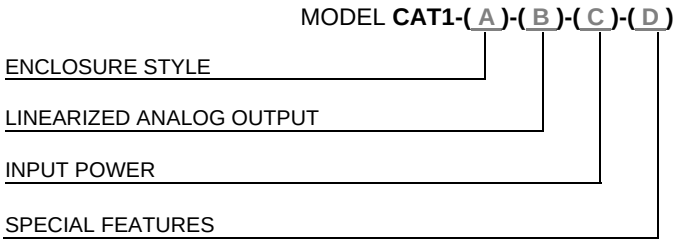
The CAT1 is a microprocessor based loop powered transmitter. The transmitter accepts a low-level frequency signal on the input and provides a 4-20mA analog output proportional to the flow rate. CAT1 is compatible with all Hoffer turbine flowmeters as well as the H.O.G. series positive displacement flowmeters.

The CAT1-L model provides for 20-point linearization of the flow input signal and outputs a linearized analog current. CAT1 is fully configurable via an RS232 communications port located under the top plate. CAT configuration software is a Windows based application that provides the interface for entering K-factors, frequencies, the timebase for rate measurement, and calibration of the analog output. Configuration and remote monitoring can also be performed using any PC based communications program (e.g., HyperTerminal) or ASCII terminal.

The standard unit is packaged in an extruded aluminum enclosure for wall mounting or may be mounted directly on a flowmeter using an optional NEMA 4X or EX enclosure. An optional bracket is also available for mounting on standard DIN rail.

An RS232 communications port located under the top plate allows CAT1 to be remotely configured using DevConfig 3.0, a PC application program that is included with all units.

1-1 Model Number Designation



ENCLOSURE STYLE

MODEL **CAT1-(A)-( )-( )-( )**

OPTION **(A)**

(1) GENERAL PURPOSE.
2.6"L X 2.6"H X 2.6"W MINIMUM MOUNTING SPACE.

(D) 2" LONG DIN RAIL MOUNT SINGLE UNIT.
UP TO 20 CAT1 UNITS CAN BE MOUNTED ON A SINGLE RAIL.
ADD 2" PER UNIT.

(E3) EXPLOSION-PROOF (ALL CONDUIT PORTS ARE ¾" FNPT)
- CSA/FM: CLASS I, DIV. 1, GR. BCD; CLASS II, DIV. 1, GR. EFG;
CLASS III, TYPE 4X, IP66;
CLASS 1 ZONE 1 AEx d IIB + H2, IP 66
- ATEX/IECEx: II 2 G Ex d IIB + H2, T1 – T6 Gb; IP66
T1-T5: -40°C ≤ Ta ≤ 85°C; T6: -40°C ≤ Ta ≤ 80°C

NOTE: FOR UL LISTED EXPLOSION-PROOF ENCLOSURES CONTACT FACTORY.

(E3M) EXPLOSION-PROOF (CONDUIT PORTS D2 & D3 = M20 THR'D;
CONDUIT PORTS D1- ¾" FNPT)
- CSA/FM: CLASS I, DIV. 1, GR. BCD, CLASS II, DIV. 1, GR. EFG;
CLASS III, TYPE 4X, IP66;
CLASS 1 ZONE 1 AEx d IIB + H2, IP 66
- ATEX/IECEx: II 2 G Ex d IIB + H2, T1 – T6 Gb; IP66
T1-T5: -40°C ≤ Ta ≤ 85°C; T6: -40°C ≤ Ta ≤ 80°C

NOTE: FOR UL LISTED EXPLOSION-PROOF ENCLOSURES CONTACT FACTORY.

(E6) EXPLOSION-PROOF STAINLESS STEEL
(ALL CONDUIT PORTS ARE ¾" FNPT)
- CSA/FM: CLASS I, DIV. 1, GR. BCD: CLASS II, DIV. 1, GR. EFG;
CLASS III, TYPE 4X, IP66;
CLASS 1 ZONE 1 AEx d IIB + H2, IP 66
- ATEX/IECEx: II 2 G Ex d IIB + H2, T1 – T6 Gb; IP66
T1-T5: -40°C ≤ Ta ≤ 85°C; T6: -40°C ≤ Ta ≤ 80°C

NOTE: FOR UL LISTED EXPLOSION-PROOF ENCLOSURES CONTACT FACTORY.

(E6M) EXPLOSION-PROOF STAINLESS STEEL **(M20 NOT AVAILABLE FOR CANADA)**
(CONDUIT PORTS T2 = M20 THR'D; CONDUIT PORTS T1- ¾" FNPT)
- CSA/FM: CLASS I, DIV. 1, GR. BCD; CLASS II, DIV. 1, GR. EFG;
CLASS III, TYPE 4X, IP66;
CLASS 1 ZONE 1 AEx d IIB + H2, IP 66
- ATEX/IECEx: II 2 G Ex d IIB + H2, T1 – T6 Gb; IP66
T1-T5: -40°C ≤ Ta ≤ 85°C; T6: -40°C ≤ Ta ≤ 80°C

NOTE: FOR UL LISTED EXPLOSION-PROOF ENCLOSURES CONTACT FACTORY.

LINEARIZED ANALOG OUTPUT

MODEL **CAT1-(__)-(B)-(__)-(__)**

OPTION **(B)**

(7) 4 TO 20 MA UP TO 20 POINTS.
ACCURACY +/-0.02% OF FULL SCALE.

INPUT POWER

MODEL **CAT1-(__)-(__)-(C)-(__)**

OPTION **(C)**

(D) 8 TO 24 VDC LOOP POWERED.

SPECIAL FEATURES

MODEL **CAT1-(__)-(__)-(__)-(D)**

OPTION **(D)**

(CE) MARK REQUIRED FOR EUROPE

(CFX) 6.75" LONG RISER AND UNION FOR EXPLOSION-PROOF **SYSTEM CERTIFIED ENCLOSURES** MOUNTED ON TURBINE. USED WITH "X" RISER TURBINE OPTION.

NOTE: IF PROCESS TEMP IS < -40°C AND > 85°C, EX-PROOF ENCLOSURE MUST BE MOUNTED REMOTELY.

(SP) ANY SPECIAL FEATURES THAT ARE NOT COVERED IN THE MODEL NUMBER, USE A WRITTEN DESCRIPTION OF THE -SP.

NOTES: 1. IF ENCLOSURE IS MOUNTED ON TURBINE FLOWMETER, RISER MUST BE SPECIFIED ON METER.

2. INPUTS: ACCEPTS MAGNETIC COIL ONLY.

3. WINDOWS® BASED SETUP AND CABLE KIT CONSISTS OF:
   1 EA. HIT2A-301
   1EA. CABLE MODEL 26886
   1 EA. WINDOWS® BASED SETUP DISC

   IF THE CAT IS SHIPPED UN-CALIBRATED, THIS MUST BE ORDERED TO CALIBRATE OR RE-CALIBRATE IN THE FIELD.

2. Specifications

Specifications

Input Signal Type:	Magnetic pick up, Contact Closure
Input frequency range:	0.2 Hz to 4 KHz
Signal level:	10 mV rms to 30 Vdc
Power supply:	Loop Power 8-30 Vdc Reverse polarity protection
Analog Output:	4-20 mA, 1-5V
Analog Output Response Time:	1/8 sec.*
Load resistance:	Max 650 Ohms at 24 Vdc
Accuracy:	+/- 0.02% of full scale @ 20^{o} C
Temperature drift:	40ppm/deg C
Communications	RS232 port for Configuration and diagnostics
Operating temperature:	-40^{o} to 85^{o} C
Humidity:	0-90% Non-condensing
Enclosure:	Extruded aluminum DIN rail mount Explosion Proof
Regulatory:	CE compliant

*Limited by signal frequency and NST settings. Refer to Section 3.2.

Options

12 Point Linearization

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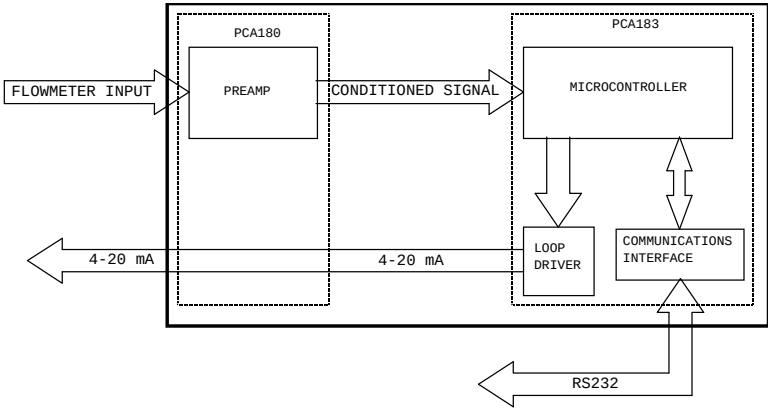
3. Principle of Operation

The CAT1 consists of two printed circuit boards and four main functional blocks: the Preamplifier, Microcontroller, Loop Driver, and Communications Interface.



3-1 Functional Blocks

3-1-1 Preamplifier

The Preamplifier, located on PCA180, accepts the input from the flowmeter. The Preamplifier applies amplification, low-pass filtering, and wave-shaping to the input signal. The wave shaping function converts the signal into a square-wave before sending it to the Microcontroller.

3-1-2 Microcontroller

The Microcontroller, located on PCA183, accepts the square-wave output of the preamplifier and performs all of the calculations that are required to control the Loop Driver. After measuring the frequency of the square-wave, the Microcontroller uses the following equations to compute the flow rate and current.

$$flowrate = \frac{frequency}{Kfactor} x60^{FM} xCF$$

Where:

Kfactor = Is dependent on the Flow Calculation Method setting and is either the Average K-Factor or the Linearized K-Factor from the Frequency / K-Factor table.

FM = Is the Flow rate Units setting of 0, 1, or 2. Where "0" is for Seconds, "1" is for Minutes, and "2" is for Hours.

CF = Is the Correction Factor setting.

$$current = 4mA + \left(16mAx \frac{flowrate}{AF} \right)$$

Where:

AF = Is the 20 mA maximum Flow rate value.

If the calculated flowrate is greater than the AF setting, the current will be set to 24mA to indicate an "Over-range" condition. After calculating the current, the Microcontroller digitally sends the current information to the Loop Driver.

3-1-3 Loop Driver

The loop driver, located on PCA183, uses the digital information sent to it by the Microcontroller to set the current of the loop. The Loop Driver also supplies power to the Microcontroller.

3-2 System Response Time

The analog output response time to reach steady state due to a change in the flow rate is approximately 1/8 of a second. When flow stops, the time for the analog output to return to 4 mA will be between .25 and 8 seconds, depending on the Maximum Sample Time (MST) setting. MST is adjusted using the NB= (DATA) command, where NB is a value between 1 and 80. The default MST setting is NB= 1. Adjusting the MST is only recommended for low flow applications where the minimum input frequency is below 1 Hz.

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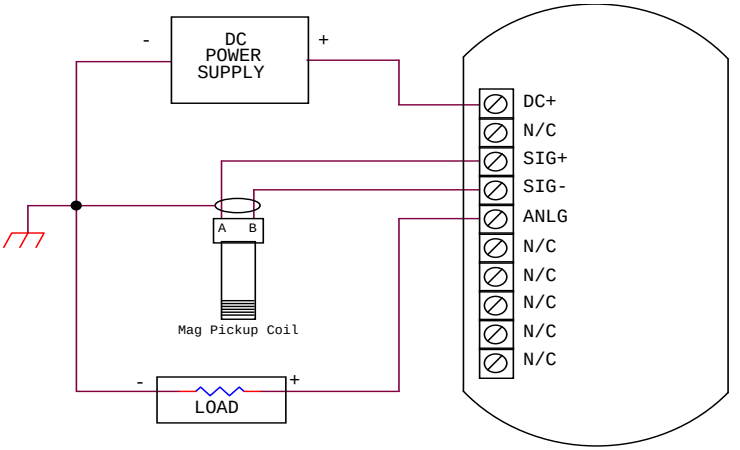
4. Installation

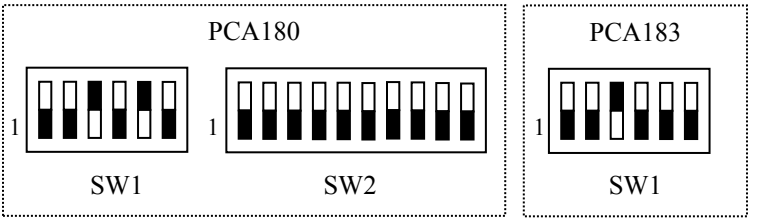
NOTE: CAT1 flow input interfaces with magnetic type pickup coils and contact closure only. If another type of coil is required, refer to CAT 2 and CAT3 models.

4-1 Typical Connections

Loop powered with MAG Coil Installation



Dip Switch Settings



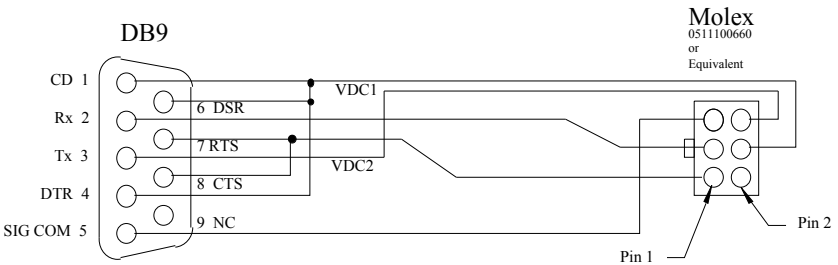
4-2 Communications Connections

CAT1 is equipped with RS232 serial communication port for changing CAT1 configuration, diagnostics functions, and flow monitoring. Hoffer communication program DevConfig 3.0 must be used to communicate with CAT1.

The RS232 serial port connector is located under the top plate of CAT1 and may be accessed by removing the two screws from the top plate. A matching connector is provided with HOFFER HIT2A-301 Communications Cable. CAT1 unit has to be powered from external supply in order to be able to communicate. Additional power for CAT1 communication circuitry is supplied by the RS232 serial port of the computer/terminal. COM port settings must be set as follows:

Baud Rate:	2400
Data Bits:	8
Parity:	None
Stop bits:	1
Handshaking:	None

HOFFER HIT2A-301 Communications Cable



4-3 Wiring

When installing the CAT1, it is good practice to use shielded cable. The shield should be connected to earth ground near the instrument. The other end of the shield should not be connected.

In order to comply with the requirements for Electromagnetic Compatibility, as per EMC-Directive 89/336/EEC of the Council of European Community, this wiring practice is mandatory.

Appendix A – Default Configuration

Factory default configuration:

FIELD	***Value***
FLOW CALC. METHOD	0 *(Average)*
K-FACTOR DECIMAL	3
AVERGAE K-FACTOR	1.00
NUMBER OF POINTS IN K-TABLE	12
FREQUENCY 01	4999.981
FREQUENCY 02	4999.982
FREQUENCY 03	4999.983
FREQUENCY 04	4999.984
FREQUENCY 05	4999.985
FREQUENCY 06	4999.986
FREQUENCY 07	4999.987
FREQUENCY 08	4999.988
FREQUENCY 09	4999.989
FREQUENCY 10	4999.990
FREQUENCY 11	4999.991
FREQUENCY 12	4999.992
K-FACTOR 01	1.00
K-FACTOR 02	1.00
K-FACTOR 03	1.00
K-FACTOR 04	1.00
K-FACTOR 05	1.00
K-FACTOR 06	1.00
K-FACTOR 07	1.00
K-FACTOR 08	1.00
K-FACTOR 09	1.00
K-FACTOR 10	1.00
K-FACTOR 11	1.00
K-FACTOR 12	1.00
MEASURING UNITS	GAL
FLOW RATE TIME UNITS	MIN
MAX SAMPLE TIME	01
ANALOG OUTPUT LOW	00000.000
ANALOG OUTPUT HIGH	99.999
PULSE SCALE	OFF
PULSE FREQUENCY	100
ALARM FUNCTION	Off
ALARM LEVEL	99999.981